U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB80-140528

Quantification of Municipal Disposal Methods for Industrially Generated Hazardous Wastes

Acurex Corp, Mountain View, CA Energy and Environmental Div

Prepared for

Municipal Environmental Research Lab, Cincinnati, OH

Aug 79

United States
Environmental Protection
Agency

Municipal Environmental Research
Laboratory
Cincinnati OH 45268

EPA-600/2-79-135
August 1979

Research and Development

PB80-140528

EPA

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TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-600/2-79-135		PB80-140528

4. TITLE AND SUBTITLE	5. REPORT DATE
QUANTIFICATION OF MUNICIPAL DISPOSAL METHODS FOR INDUSTRIALLY GENERATED HAZARDOUS WASTES	August 1979 (Issuing Date)
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
H. VanNoordwyk, L. Schalit, W. Wyss, H. Atkins	79-331
9. PERFORMING ORGANIZATION NAME AND ADDRESS Acurex Corporation Energy and Environmental Division 485 Clyde Avenue Mountain View, California 94042	10. PROGRAM ELEMENT NO. 1DC818, SOS 4, Task 26 11. CONTRACT/GRANT NO. 68-03-2567
12. SPONSORING AGENCY NAME AND ADDRESS Municipal Environmental Research Laboratory--Cin.,OH Office of Research and Development U.S. Environmental Research Laboratory Cincinnati, Ohio 45268	13. TYPE OF REPORT AND PERIOD COVERED Final 1978 - 1979 14. SPONSORING AGENCY CODE EPA/600/14

15. SUPPLEMENTARY NOTES

Project Officer - Thomas L. Baugh 513/684-7881

16. ABSTRACT

Estimations of the amounts of industrial hazardous wastes being disposed of according to various methods of disposal were generated for significant portions of the five following SIC codes: 28, Chemical and Allied Products; 29, Petroleum Refining and Related Industries; 30, Rubber and Miscellaneous Plastic Products; 31, Leather and Leather Products; 36, Electrical and Electronic Machinery, Equipment, and Supplies. The portions studied account for approximately half of the industrial hazardous waste disposed of in this country. The following conclusions may be drawn from the study:

- o over 18 million tonnes per year of hazardous waste are generated by the industries studied. Municipal disposal of industrial hazardous waste accounts for approximately 9 percent of all such waste generated. Therefore, between 2.5 and a little over 3 million tonnes per year are going to some form of municipal disposal.
- o Industrial hazardous wastes which are municipally disposed are those that present by and large, less acute environmental and safety hazards in their disposal than do other industrial hazardous wastes which are disposed of onsite or in offsite private facilities. However, in terms of possible chronic environmental hazard, these wastes have a high hazard potential because of their content of heavy metals and other persistant toxic chemicals such as halogenated organics.
- o over 99 percent of industrial hazardous waste that are municipally disposed of end up in municipal facilities not designed for their incorporation. Long term environmental problems can be expected from such disposal methods.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Waste disposal, Waste disposal-- industrial wastes	Hazardous wastes, Municipal disposal methods, Waste quantification, Chemical and Allied Products Industry, Petroleum Refining and Rerefining Industry, Rubber and Miscellaneous Plastic Products Industry, Leather and Leather Products Industry, Electrical and Electronic Machinery, Equipment, and Supplies Industry	13B

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Release unlimited	unclassified	75
	20. SECURITY CLASS *(This page)*	22. PRICE
	unclassified	

EPA Form 2220-1 (9-73)

☆ U.S. GOVERNMENT PRINTING OFFICE: 1979-657-060/5386

EPA-600/2-79-135
August 1979

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimony to the deterioration of our natural environment. The complexity of that environment and the interplay between its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution, and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems for the prevention, treatment, and management of wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, for the preservation and treatment of public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research; a most vital communications link between the researcher and the user community.

This study involved estimating the quantities of industrial hazardous waste being disposed of according to various methods of disposal. Recent assessment studies of hazardous waste treatment/disposal practices and current state and local hazardous waste surveys provided the data base for the estimates. Methods used to dispose of about half of the industrial hazardous waste generated in this country were reviewed.

Francis T. Mayo, Director
Municipal Environmental
Research Laboratory

EXECUTIVE SUMMARY

Many industrial wastes are known to be sent to public disposal facilities. Indeed, many public facilities actively solicit such materials one way or another; a common technique is the use of a favorable rate structure coupled with an uncritical analysis of the potential eventual environmental effect on ground water or land use options.

The Municipal Environmental Research Laboratory (MERL) of the Office of Research and Development of the Environmental Protection Agency has the charter to develop data on public sector waste disposal requirements and perform research to develop needed disposal technologies. There are no known compilations of broadly-based (i.e., nationwide) data pertaining to public sector disposal of industrial hazardous wastes. These data are needed if effective research program planning is to be accomplished. Acurex has, in this study, attempted to compile and review for MERL all data on this topic which were readily available to us within the level of effort permitted by time and budget constraints.

The specific objective of this study is to quantify the amount of industrial hazardous waste disposed of in public sector facilities. This analysis seeks to quantify industrial hazardous wastes by waste types, by waste disposal methods, and by the generator's Standard Industrial Classification (SIC) code. Limited data is available on these topics. After an extensive search for data, five SIC codes which include major contributions of hazardous waste were successfully analyzed for their hazardous waste contributions to the municipal sector.

The initial approach taken to determine this contribution proved unworkable because of deficiencies in the data available from the states. The approach finally adopted uses EPA's hazardous waste assessment reports as the basis for national waste quantity estimates and uses state data for estimating the distribution of waste types by disposal method.

Information was also sought from other sources. These included both individual companies and trade associations, other contractor reports and disposal vendors. Most of these proved to be of limited value.

Thirty-one state agencies supplied reports or data on the generation and disposal of industrial hazardous waste. These data were only partially useful because of the lack of a uniform definition of a hazardous waste and because there is inconsistency among state agencies in the methods used for obtaining and reporting waste generation and disposal information. Disposal methods for specific waste types generated by various SIC codes were quantified by 10 states. Adequate disposal data from states in which the largest quantities of waste are generated, such as Texas, Louisiana, and Ohio, were not readily available. Many details are lacking in the available

data. For example, it is extremely rare to find data on the ownership of the disposal facility.

The industrial hazardous waste "assessment" reports sponsored by the EPA Office of Solid Waste Management Programs during the early and mid-1970's proved to be the most useful source of waste quantity data. These reports characterize and quantify industrial hazardous wastes in selected industries. They also briefly describe treatment and disposal methods. However, as in the case of state-supplied data, ownership of the commonly-used disposal sites (i.e., public or private) is not usually specified.

Private industry, trade/technical associations, and other sources supplied some data. Most of these were not specific enough to be used in this study.

During our analysis of available data, we determined that conclusions could be drawn about the hazardous waste contribution to the municipal sector from significant portions of the following SIC codes:

SIC Code No.	Name
28	Chemicals & Allied Products
29	Petroleum Refining & Related Industries
30	Rubber & Miscellaneous Plastic Products
31	Leather & Leather Products
36	Electrical & Electronic Machinery, Equipment & Supplies

We have concluded that, for these SIC codes, our conclusions are based on almost 90 percent of the hazardous waste generated by these industrial categories.

For these SIC codes, the tables in Section 6 of this report present, where possible, the disposal methods used for all waste types. In all cases, for each SIC code or code segment addressed, all disposal methods have been quantified either by specific waste types or by the total quantity of hazardous industrial waste.

Table 1 summarizes our conclusions on the disposal methods and amount of industrial hazardous waste by SIC code or code segment. The data show that most of those wastes (>90 percent) which are municipally disposed, go to General Purpose landfills. Petroleum Refining, Industrial Inorganic Chemicals, Plastic and Synthetics, Organic Chemicals, and Leather Tanning and Finishing generate over 90 percent of the municipally-disposed hazardous industrial waste produced by the tabulated industries.

In this study, disposal of about half of the industrial hazardous waste in this country has been reviewed. Of that, over 9 percent ended up

TABLE 1. OFFSITE (PUBLIC AND PRIVATE) AND ONSITE INDUSTRIAL HAZARDOUS WASTE DISPOSAL BY STANDARD INDUSTRIAL CLASSIFICATION (SIC) CODE OR SIC CODE SEGMENT

SIC Code/Code Segment Number	SIC Name	Quantities and Disposal Methods[a] Tonnes/Year, 1977 (Wet Basis)														
		Offsite									Onsite					
		Public			Private											
		Landfill[b]	Sewer	Other[c]	Landfill[b]	Special Landfill[d]	Ponding/ Lagooning	Incineration	Recovery	Other[c]	Landfill[b]	Special Landfill[d]	Ponding/ Lagooning	Injection	Incineration	Recovery	Other[c]
281	Ind. Inorganic Chem.	427,000	<40,000	<40,000	117,000	298,000	117,000			51,000	1,750,000	117,000	952,000				56,000
282	Plastics & Synthetics	284,000	--	--				209,000							27,100		210,000
283	Pharmaceuticals	≤230	≤90	--	7,700			36,800	700	≤300					26,000		≤1,700
285	Paints & Coatings	1,900	--	--	96,900			2,100			12,100				1,100		
2861, 2865, 2869 (except 28694)	Organic Chemicals	≤205,000	--	--	500,000			120,000			440,000		520,000	6,000,000	2,100,000	240,000	
28694, 2879	Pesticides[e]	25,000	--	--	50,000			95,000			176,000				5,000	50,000	81,000
2892	Explosives	--	--	--	570					2,400	570						21,700
2911	Petroleum Refining	428,000	--	--	107,000		289,000	2,000[f]		2,000[f]	355,000		284,000		40,000		334,000
2922	Petroleum Rerefining	9,700	--	--	41,000				7,700[g]		8,100					7,700[g]	
30	Rubber Products	37,600	--	500	9,400	1,900					2,400						170
3111	Leather Tanning & Finishing	45,800	--	45,800	51,200	9,700	6,200			2,100	4,800		5,300				1,900
367	Electronic Components	31,600	--	--	31,300			6			9,500				6		
3691/3692	Batteries	47,200	--	--	47,200	12,300					45,200	12,300				10	
	Totals	~1,543,000	<40,100	~86,300	1,066,000	~322,000	~412,000	~665,000	8,400	~58,000	~2,803,000	~129,000	~1,761,000	6,000,000	~2,199,000	~298,000	~706,000

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[a]These data come from the EPA OSW assessment reports listed in Table 5-3 and are distributed according to information in those reports and collected state reports/data summaries (see Table 5-1 and the appendix).
[b]General purpose landfills
[c]See Section 6 tables and their respective footnotes for explanations of "Other" disposal methods.
[d]Landfills approved for hazardous waste disposal. See Section 6 tables for more specific information.
[e]144,000 tonnes/year to unknown disposal; not included in above table
[f]4,000 tones/year -- split evenly between incineration and other (landspread) since actual distribution is unknown
[g]15,400 tonnes/year -- split evenly between onsite and offsite (private) recovery since actual distribution is unknown.

disposed in the municipal sector. Although most industrial hazardous waste disposed of municipally does not present acute environmental and safety hazards, it does have a significant potential for causing chronic environmental hazard since it contains hazardous constituents such as heavy metals and halogenated organics which are not readily removed. More than 99 percent of the hazardous waste municipally disposed of which was examined in this study goes to facilities not designed for its acceptance. As a result of such flagrant disposal errors, long-term environmental problems are to be expected.

Much of the hazardous waste disposed of onsite by industry or offsite in private facilities is also expected to lead to long-term environmental problems primarily due to poorly designed facilities. These problems may be much more serious than those encountered in the municipal sector for two reasons. First, there is usually a much higher concentration of hazardous wastes in such private facilities and, second, the wastes in such facilities are typically even more hazardous the hazardous waste which enters public sites.

If realistic planning is to occur, future in-depth studies are needed of specific industries' hazardous waste contributions to municipal disposal facilities. This study can serve as a preliminary indicator of the priority SIC codes which should be investigated first. Such studies should attempt to quantify the compositions of these wastes and then include recommendations for their treatment and disposal.

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SECTION 1

INTRODUCTION

The purpose of this study is to provide a data base for future research planning. Thus, it attempts to examine and estimate the amount, nature, and method of disposal for hazardous and toxic wastes generated by industry and disposed of in public facilities. At present, there are no nationwide quantitative data compilations on industrially generated toxic and hazardous wastes that undergo municipal treatment and/or disposal. As part of the Municipal Environmental Research Laboratory, the Solid and Hazardous Waste Research Division is charged with the assessment, development and demonstration of technologies capable of rendering innocuous any toxic or hazardous waste that is discharged to the municipal sector. The development of specific technologies that will have the greatest impact on the treatment/disposal of hazardous waste requires a knowledge of the character of the waste. Information contained in this report, such as specific wastes being generated, the industrial origin of these wastes, and the current methods of disposal will provide a portion of the data base necessary for future research.

1.1 OBJECTIVES

The objectives of this study are to quantify the amounts and specify the types of hazardous waste generated by various industries for those wastes disposed of in public disposal facilities, and to examine differences in the way in which wastes from various industries are treated and disposed of.

1.2 SCOPE OF WORK

The lack of broadly-based (i.e., nationwide) data compilations on this topic was felt to require extrapolation of existing piecemeal data if the objective was to be reached.

Acurex's scope of work therefore contained the following tasks:

- Collection of Data. Potential sources of data were thought to be compilations or surveys by government agencies, expert opinion, and cross-check data from private sector generators of wastes and from private disposal sites.

- Assessment of collected data and development of an analytical model for extrapolation of local data to national scope

- Use of the analytical model to perform the extrapolation to provide answers to the questions:

  -- How much hazardous waste is being generated nationally by various industries

  -- What part of industry-generated waste is disposed of in public facilities

  -- What differences exist in the way wastes from various industries are treated and disposed of in public disposal facilities

Further, in estimating the nationwide patterns of industrial waste disposal, an attempt was to be made to prioritize the work effort by ranking industries by the nature of their wastes, since it was felt that it might not be possible to achieve results for all industries.

1.3 REPORT ORGANIZATION

Conclusions and recommendations derived from this study are given in Section 2.

Section 3 describes the approach originally chosen to reach the objectives stated in Section 1.1. During the study, the approach was modified as a result of conclusions reached after assessing the data initially collected. The reasons for modifying the approach are described together with the modified approach.

The data sources used are covered in Section 4. Section 5 describes characteristics of these data and contains a few comments on their usefulness.

Finally, section 6 describes the model used and the results achieved by the model.

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

2.1 CONCLUSIONS

The following conclusions can be drawn:

- Industrial hazardous wastes which are municipally disposed are those that present, by and large, less acute environmental and safety hazards in their disposal than do other industrial hazardous wastes whch are disposed of onsite or in offsite private facilities. However, in terms of possible chronic environmental hazard, these wastes have a high hazard potential because of their content of heavy metals and other persistant toxic chemicals such as halogenated organics.

- This study indicates that municipal disposal of industrial hazardous waste handles just over 9 percent of all such waste generated. Over 99 percent of this portion ends up in municipal facilities not designed for its incorporation. Long term environmental problems can be expected from such disposal methods.

- Over 18 million tonnes per year of hazardous waste are generated by the industries studied. If recent estimates putting national hazardous waste generation between 28 and 36 million tonnes per year are correct, then at least half of the country's hazardous waste has been surveyed in this report. If about 9 percent is being disposed of in the municipal sector then between 2.5 and a little over 3 million tonnes per year are going to some form of municipal disposal.

2.2 RECOMMENDATIONS

Two recommendations are made as a result of this study and are detailed in the next two sections.

2.2.1 Data Base Improvement

It would be useful for program planning if the EPA could establish basic information gathering requirements for hazardous waste that would compile this information on a national basis. Such information requirements should include, at a minimum, common units of measurement,

common units conversion factors, and, for each SIC code waste quantity, the distribution by waste type and by disposal method. Such information could be generated by survey or the initiation of a state manifest program for hazardous wastes. Accuracy to within ±10 to 20 percent would provide better planning data than currently available.

2.2.2 Further Useful Work

Studies should be made of specific industries' hazardous waste contributions to municipal disposal systems. This preliminary study could serve as an indicator in the prioritization of these studies. Industries which contributed almost 90 percent of the hazardous wastes reviewed herein to municipal systems were, in order of rank: petroleum refining, inorganic chemicals, plastics and synthetics, pesticides, and leather tanning and finishing. Such studies should also encompass those hazardous wastes being disposed of in private offsite facilities.

Criteria could also be developed which would allow municipal disposal facilities to determine whether they could handle particular hazardous wastes.

SECTION 3

APPROACH

In this section we briefly review the original approach, the reasons -- based upon an analysis of the data search experience and the information collected -- why this approach was abandoned, and the revised approach which was used to achieve the objectives of the study.

3.1 ORIGINAL CONCEPT

Several states -- notably California, Texas, and Maryland -- have been collecting data for several years on the disposal of industrial wastes. California and Texas, for example, have been requiring waste disposal manifests from waste generators, transporters and disposers. California was known to have computerized useful data. Texas officials had, in 1977, stated their plans to issue summary data in 1978 in discussions with Acurex staff during an earlier project. Maryland had performed a survey of waste generation and disposal for about one-third of the industrial firms in the state and had issued a summary report, as had several other states in which survey data was collected.

It was thought that these data, in one of more states, might provide enough credible information about wastes from particular SIC codes to allow extrapoltion for those SIC codes for the United States as a whole. Data gathered, as feasible, from private industry generators and various disposal sites would then provide spot cross-checks on specific SIC waste estimates.

3.2 ASSESSMENT OF INITIAL DATA COLLECTION RESULTS

Acurex attempted to collect data from the 48 contiguous states. Thirty-one responded. These data were generally found to be inconsistent, both within individual reports and between reports from different states, extremely sketchy and incomplete, and reported in a nonuniform fashion.

As an example, some reports gave statewide totals for various kinds of waste. Others gave statewide totals (for all waste kinds) by SIC code. Very few reports gave the crucial datum of type-of-waste-by-SIC-code. (Several state reports did; unfortunately those reports were for states which generate only minor fractions of national waste totals, and we did not wish to base extrapolations on such a limited base.)

It also became apparent that there was no concensus on the meaning of the term "hazardous waste." The need for an operational definition of this term has been known to EPA since the Congress incorporated it into the Resource Conservation and Recovery Act of 1976. No operational definition has, as of the date of this report, been adopted; thus, it is not possible to test (operationally) or otherwise establish that a given waste is or is not hazardous. (As a result, this report will generally try to include the descriptors present in the data sources which we used to draw our conclusions.)

3.3 REVISED APPROACH

As stated above, data in the state reports often are not at the needed level of detail. However, several state reports provide data on the types of wastes, by SIC code, and others give data on the method of disposal, by SIC code.

The Office of Solid Waste had previously brought into existence a sequence of contractor reports. Each of these "assessment studies" addresses the wastes in a major industrial category. A review of these reports indicates that they contain credible nationwide totals for quantities of industrial wastes, although they rarely specify the method of disposal by type of waste for the industrial category addressed. Some of these reports do attempt to provide both "total waste" quantities and "hazardous waste" quantities.

At this point, it became important to examine whether a combination of these data could be used to reach <u>useful</u> conclusions.

We decided that it appeared probable that conclusions could be reached for several SIC codes. These SIC codes have two important characteristics:

- These industries are believed to generate substantial portions of the total quantity of "hazardous" waste created each year, according to the OSW contractor reports
- These industries correlate substantially with the proposed listing of hazardous waste streams (Federal Register, December 18, 1978, pp. 58958-58959)

The approach chosen then uses the OSW assessment reports as an initial source for the total (nationwide) quantity of waste, subject to further cross-checking. If quantatative estimates of disposal methods or waste types are lacking in these reports, which is often the case, then these kinds of data are sought from the state reports. State report estimates -- particularly those published most recently --are also used to cross-check quantity estimates. Where these two data sources prove inadequate, other data are sought.

We decided that extrapolation appeared feasible for data from SIC codes 28, 29, 30, 31, and 36. These SIC codes appear to generate about 47 percent of the total quantity of hazardous wastes listed in the OSW

assessment reports. They also include a major portion of the proposed listed hazardous waste streams.

Section 6 of this report summarizes the data collected and the results obtained using the revised approach. These results achieve the objectives stated in Section 1.1.

SECTION 4

DATA SOURCES

In the data acquisition phase of this project, we called various potential governmental data sources to request current information on quantities and compositions of industry-generated waste streams and their methods of disposal. Pertinent data was also sought from documents already catalogued in Acurex library files. Additional EPA or EPA contractor reports were sought as were other contractor reports, journal articles, and expertise from specific individuals or private concerns. Table 4-1 lists many of the sources from which we sought data and tells where data were received.

Many states have conducted hazardous waste studies. Since these efforts are not coordinated on a national scale, the state agency designated to conduct the study may have been any one of several, including: Department of Public Works, Office of Solid Waste, Solid Waste Management Section, Department of Environmental Quality, Department of Water Resources, etc. Each has its particular responsibilities, scope of authority, and resources. The appropriate agency was contacted in every state except Alaska and Hawaii. These were not included because only minimal amounts of hazardous wastes are disposed of in these two states.

For economic and liability considerations, industrial companies control and monitor their waste streams. Information-seeking efforts were focused on several of the "Fortune 500" companies since data from any one, if complete, would have been of potential value to this study.

Trade associations were a potential source of data from industry since, in compiling information volunteered by their members, they provide the anonymity desired by many individual companies. Qualitative data were provided from several associations; others referred us to data already furnished to the OSW.

Managers of disposal services and sites estimate amounts of wastes in order to fix fees and may also request a description of waste components. Such data are often unverified but are useful for rough estimates. As hazardous waste manifest requirements become more widely required and more uniform in content, these data will become of greater utility, particularly if, as is already in the case in California, monthly and annual summary data are compiled.

TABLE 4-1. HAZARDOUS WASTE DATA SOURCES

Source	Information Provided
Trade/Technical Associations	
National Solid Waste Management Association	No
National Center For Resource Recovery	No
Minnesota Association of Commerce and Industry	No
Association of Metropolitan Sewerage Agencies	Yes
Water Pollution Control Federation	No
Hazardous Materials Control Research Institute	No
National Council of the Paper Industry for Air and Stream Improvement	No
Federal Governmental Agencies	
US EPA Hazardous Waste Management Division/OSW	Yes
US EPA Regional Offices (all 10 offices)	Yes, by Region X
US EPA Effluent Guidelines Division/OWPS	No
Department of Commerce	Yes
Department of Energy	No
State Governmental Agencies	
48 contiguous states	Yes, by 31 states
Disposal Facilities or Companies	
Industrial Tank Company (two California locations)	Qualitative
Los Angeles County Landfill, California	Qualitative
Ventura County Landfill, California	Qualitative
San Diego County Landfill, California	Qualitative
Rollins Disposal Services (Texas, New Jersey)	Qualitative
ENSCO Hazardous Waste Incinerator (Arkansas)	Qualitative

TABLE 4-1. Continued

Industrial Organizations	
Aluminum Company of America	Yes
American Standard Inc.	No
Bethlehem Steel Corp.	No
Boise Cascade Paper Group	No
Boysen Paint Co.	Yes
Brown Group Co.	No
Evans Products Co.	Yes
General Dynamics Corp.	No
General Electric Co.	No
Georgia Pacific Corp.	Yes
Goodyear Tire and Rubber Co.	No
W. R. Grace & Co.	No
Hewlett-Packard Co.	Yes
Johns-Manville Corp.	No
Johnson & Johnson	No
Kelly-Moore Paint Co., Inc.	No
Monsanto Co.	No
Ogden Manufacturing and Sales Inc.	No
Owens-Corning Fiberglass Corp.	No
Owens-Illinois Inc.	No
U.S. Gypsum Co.	Yes
U.S. Steel Corp.	Yes
Warner Lambert Co.	No
Weyerhaeuser Co.	No
Union Carbide Corp.	Yes
Eastman Kodak Corp.	Yes

Acurex's in-house collection of EPA and contractor documents was utilized. Additional reports were acquired through literature searches.

SECTION 5

UTILITY AND CHARACTERISTICS OF THE DATA COLLECTED

Hazardous waste generation and disposal data were received from approximately 50 percent of the sources listed in Table 4-1. Several hundred EPA and contractor reports were also analyzed after reviewing their abstracts. These abstracts were obtained from the Solid Waste Information Retrieval System (SWIRS) computerized data base.

5.1 STATE REPORTS

Forty-eight state agencies with waste disposal data were reached by telephone. Information relating to waste generation and waste disposal was sought. Thirty-one state agencies responded by sending complete or partial reports, report summaries, tabulated data, or computer printouts. A summary of the types of information received from state agencies is given in Table 5-1.

The data provided by the state agencies proved to be only partly useful since they did not use a uniform definition of a hazardous waste or a consistent method for obtaining or tabulating quantitative waste generation and disposal information.

Since no uniform criteria exist to define which solid wastes are hazardous, wastes of similar characteristics are reported as hazardous in some states while in others they are not.

For example, New Jersey specifically lists the wastes considered hazardous while Maryland utilizes a set of criteria based on bioconcentration, flammability, toxicity, corrosiveness, etc., to establish a working definition of hazardous wastes. Several states define hazardous waste as "...any waste, or combination of wastes, of a solid, liquid, contained gaseous, or semisolid form, which because of its quantity, concentration, physical, chemical, or infectious characteristics may (a) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness, or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed." Unfortunately, no method is usually provided to test whether a given waste is or is not hazardous according to this definition. Indeed, different wastes are considered hazardous by various states according to this definition.

TABLE 5-1. SUMMARY OF STATE REPORT DATA

EPA Region	State	Report or Data Available	Received	Report Date	Waste Quantity Data Base[b]	Waste Identified by SIC[c]	Disposal Quantitatively Identified[d]	Remarks
I	Maine	Yes	Yes	6/78	S/E	Yes - 2/12	Partial - SIC/CAT	
	New Hampshire	Yes[a]	No	--	--	--	--	
	Rhode Island	Yes	Yes	3/77	S	Yes - 3/23	Yes - SIC/CAT	
	Vermont	Yes[a]	Yes	--	S	Yes - 4/15	Yes - SIC	Status report received, survey not complete
	Connecticut	Yes	Yes	8/77	S/E	Yes - 2/11	Yes - CAT	
	Massachusetts	Yes	Yes	10/76	S/E	Yes - 3,4/16	No	
II	New York	Yes[a]	Yes	--	S	Yes - 4/203	No	Draft copies of report components have been received -- final report not available. 1/75 preliminary report received
	New Jersey	Yes	Yes	1974	Estimate	Yes - 2,3/23	No	
	Delaware	Yes	Yes	10/78	S	No	Yes - CAT	
III	Maryland	Yes	Yes	5/77	S/E	Yes - 2/18	Yes - CAT	
	Pennsylvania	Yes	Yes	11/76	Estimate	Yes - 2,3/19	No	
	Virginia	No	--	--	--	--	--	
	West Virginia	Yes	Yes	--	S/E	Yes - 2/8	Yes - SIC/CAT	Portions of preliminary draft received
IV	Kentucky	Yes	Yes	1/78	S	No	Yes - CAT	
	Mississippi	Yes	Yes	8/75	S	Yes - 2/13	No	
	Alabama	No	--	--	--	--	--	
	Georgia	No	--	--	--	--	--	
	Florida	Yes	Yes	11/77	S	Yes - 4/39	Yes - SIC	
	So. Carolina	Yes	Yes	9/78	S/E	Yes - 2/12	Yes - CAT	
	No. Carolina	Yes[a]	No	--	--	--	--	
	Tennessee	Yes	Yes	1971	S	No	No	Report addressed solid wastes generated, not hazardous waste

[a]Report was being prepared or data were still being collected as of the end of 1978

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[b]The letter "S" signifies that hazardous waste data was developed by a survey of waste generators. The letter "E" signifies that survey data was extrapolated to represent State-wide totals

[c]"Yes" if quantified waste data were presented by SIC code. "X/XX indicates the number of digits for each SIC category and the total number of categories, respectively

[d]"Yes" if waste disposal was addressed quantitatively. "SIC" signifies that waste disposal information was presented for SIC categories. "CAT" signifies that waste disposal information was presented for waste categories, (e.g., acids, bases, oils, solvents, etc.).

TABLE 5-1. Continued

EPA Region	State	Report or Data Available	Received	Report Date	Waste Quantity Data Base[b]	Waste Identified by SIC[c]	Disposal Quantitatively Identified[d]	Remarks
V	Illinois	No	--	--	--	--	--	
	Indiana	No	--	--	--	--	--	
	Minnesota	Yes	Yes	10/78	S/E	Yes - 2,3,4/32	Yes - CAT	
	Wisconsin	Yes	Yes	1977	S/E	No	No	
	Ohio	Yes[a]	Yes	--	S	No	Yes	Very brief summary of results received
	Michigan	No	--	--	--	--	--	
VI	Arkansas	No	--	--	--	--	--	
	Oklahoma	Yes	Yes	3/78	Not specified	No	Yes	Very limited data
	Texas	Yes	--	--	Manifests	Yes	Yes - CAT/SIC	Data available in files only
	Louisiana	Yes	Yes	11/78	S	Yes 2,3,4/-50	No	Report presented limited quantitative data
	New Mexico	No	--	--	--	--	--	Survey recently started
VII	Iowa	Yes	Yes	4/77	S	Yes - 2/16	Yes - CAT	
	Missouri	Yes	Yes	--	--	No	No	Brief summary received -- Specific survey data available on file
	Kansas	Yes	Yes	3/77	S/E	Yes - 2/14	Yes - CAT	
	Nebraska	Yes	Yes	12/76	S	Yes - 3/32	Yes - CAT/SIC	
VIII	Montana	Yes	Yes	12/77	S	Yes - 2/15	Yes - CAT/SIC	
	No. Dakota	No	--	--	--	--	--	
	So. Dakota	No	--	--	--	--	--	
	Wyoming	No	--	--	--	--	--	
	Colorado	No	--	--	--	--	--	
	Utah	No	--	--	--	--	--	

[a]Report was being prepared or data were still being collected as of the end of 1978

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[b]The letter "S" signifies that hazardous waste data was developed by a survey of waste generators. The letter "E" signifies that survey data was extrapolated to represent State-wide totals

[c]"Yes" if quantified waste data were presented by SIC code. "X/XX indicates the number of digits for each SIC category and the total number of categories, respectively

[d]"Yes" if waste disposal was addressed quantitatively. "SIC" signifies that waste disposal information was presented for SIC categories. "CAT" signifies that waste disposal information was presented for waste categories, (e.g., acids, bases, oils, solvents, etc.).

TABLE 5-1. Concluded

EPA Region	State	Report or Data Available	Received	Report Date	Waste Quantity Data Base[b]	Waste Identified by SIC[c]	Disposal Quantitatively Identified[d]	Remarks
IX	California	Yes	Yes	1976, 1977	Manifest/S	Yes - 4/Many	Yes - CAT/SIC	Two regional studies and computer printouts of manifest data for various parts of the State
	Nevada	Yes	No		--	--	--	Regional waste survey for Reno and Las Vegas. No State-wide data
	Arizona	Yes	Yes	1977	S/E	Yes - 2/12	No	1974/1975 reports received
	Hawaii	Not contacted	--	--	--	--	--	
X	Washington	Yes	Yes	12/74	S/E	Yes - 3/42	No	
	Idaho	Yes	Yes	6/73	S	Yes - 3/30	No	
	Oregon	Yes	Yes	3/74	S/E	Yes - 2,3,4/15	Yes - SIC/CAT	Report primarily addressed solid waste management with no hazardous waste data given
	Alaska	Not contacted	--	--	--	--	--	

[a]Report was being prepared or data were still being collected as of the end of 1978

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[b]The letter "S" signifies that hazardous waste data was developed by a survey of waste generators. The letter "E" signifies that survey data was extrapolated to represent State-wide totals

[c]"Yes" if quantified waste data were presented by SIC code. "X/XX indicates the number of digits for each SIC category and the total number of categories, respectively

[d]"Yes" if waste disposal was addressed quantitatively. "SIC" signifies that waste disposal information was presented for SIC categories. "CAT" signifies that waste disposal information was presented for waste categories, (e.g., acids, bases, oils, solvents, etc.).

The lack of uniformity with which state agencies conducted their hazardous waste surveys also made it difficult for us to use much of the data contained in the state reports for purposes of this project.

The state agencies generally obtained hazardous waste data through the use of questionnaires mailed to all known or to some fraction of the known waste generators. Based on the initial responses received, some agencies conducted actual plant surveys. Others attempted to promote additional responses by telephone or undertook second mailings of the questionnaire. In most states, waste generators were not legally obligated to respond to state surveys. Consequently, many generators chose not to do so.

The quantitative accuracy of the data in these reports varies from state to state depending on the way the survey was conducted. Data obtained from actual plant visits by state agency solid waste personnel appears more reliable than data obtained from questionnaires. Some state agencies attempted to extrapolate the data collected to estimate total hazardous wastes generated statewide. Other states made no efforts at extrapolation. Many state reports do not clearly identify the basis for the reported data. That is, they do not identify whether the reported data represent only respondent generators or whether they represent all waste generators within the state. Much effort was expended in determining unreported facets such as these.

Another shortcoming of the hazardous waste generation and disposal data provided by the state reports is that waste quantities are not classified uniformily from one state to another. Many states categorize overall waste quantities by SIC code while other quantitatively classify waste quantities by waste characteristics, (i.e., solvents, acids, bases, and oils).

Disposal information is also not reported in a uniform manner. Of the 20 states which quantitatively identify waste disposal by disposal method, the majority only present information which identifies the disposal method by waste type. Table 5-2 reproduces an example from the Minnesota report.

Disposal methods for specific waste types are quantitively identified by SIC categories in 10 of the 31 state reports. Unfortunately, the waste quantities generated by these states are only a small fraction of the national total. Adequate disposal data from the largest waste generator states such as Texas, Louisiana, Ohio, New York, Illinois, Pennsylvania, etc. are not available.

Only a small number of the state reports which list waste disposal data by SIC generators further identify wastes which end up in the municipal sector. Disposal of wastes by "landfill" or by "sewering" is identified in some reports. However, ownership of the landfill or wastewater treatment plant is usually not identified.

TABLE 5-2. WASTE TYPES (IN TONS) AND DISPOSAL METHODS[a]

Waste	Disposal Method										
	Municipal	NPDES Permit	Incineration	Sanitary Landfill	Land-spreading	Lagooning	Resource Recovery	Trash Hauler	Chemical Treatment	Other	Totals
Oil	164.5		64.5	259.1	30.3		131.5	18.9		56.0	725
Solvents	1.9		535.4	81	4.2		1422.4	75.5		24.4	2145
Flammables			135.7		3827					247.5	4210
Oxidizers	2.2		3								5
Explosives			2								2
Irritants & Corrosives	21.5		4	456.8	9	1803	2.4	3.8		46.3	2347
Wastewater Sludges	1.6			4200	2460					200	6861.6
Pesticides				0.04							0.04
Paints	0.3		377	278.4	2.5		787.5	94.4			1540
Heavy Metals	8.9	3.5							45.2		58
Other Poisons	4.3		3.4			4			33		45
Other	0.4										
Totals	206	4	1125.0	5275.3	6333	1807	2343.8	192.6	78.2	574.2	17938

[a]"The Impact of Hazardous Waste Generation in Minnesota," October 1977.

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5.2 PUBLISHED DATA SOURCES

Approximately 450 literature abstracts obtained through the SWIRS computerized data base were reviewed. Although a number of these documents report quantitative waste generation values, the majority do not report the values in detail nor do they address disposal methods quantitatively on a regional or national basis.

One important series of contractor-prepared reports, sponsored by the EPA's Office of Solid Waste, describes hazardous waste practices in a number of major SIC categories. These 15 reports characterize and quantify the land-destined hazardous wastes generated by selected industries and also attempt to characterize treatment and disposal technologies currently being practiced by those industries. A tabulation of the 15 contractor reports is given in Table 5-3.

These "assessment" reports provide useful hazardous waste generation and disposal data. The reports assess specific industries on a nationwide basis. Some of the reports list the significant production units within the industry. Hazardous waste streams generated by most of the industries are characterized and quantified. Data was obtained from literature sources and actual plant surveys. In some cases, the results use data from the sampling and analysis of waste streams.

Disposal of hazardous wastes by each specific industry is generally addressed in these reports by categorizing practical treatment and disposal technologies as (1) those which are currently and commonly practiced by the majority of waste generators (Level I Technology); (2) those which are the most environmentally sound methods currently employed (Level II Technology), and (3) that which will provide adequate health and environmental protection (Level III Technology). Each of these levels of treatment and disposal technology is identified. Either the number of generators utilizing each level of technology or the quantity of wastes disposed of by each method is reported. It was generally not possible to determine the amounts disposed of in municipally owned or operated sites from these reports although some estimates are given.

5.3 INDUSTRIAL DATA SOURCES

None of the 26 companies contacted during this study had survey data in the form of reports which could be made available on short notice. Some companies did attempt to estimate quantities of waste generated by their plants by SIC code. A total of nine firms responded. The information obtained was fragmentary. Two sources estimated the percent of their wastes going to the municipal sector. There data were used to cross-check the state report data for the SIC codes involved. No data on waste stream conpositions was provided.

Our judgment is that most of these companies would be willing to provide data but that the time constraints of this program proved incompatible with the length of time required for decisions to be reached and data to be assembled within the corporate structures we approached.

TABLE 5-3. OSW INDUSTRIAL HAZARDOUS WASTE ASSESSMENT REPORTS

Industry	SIC	Prepared By	Date	EPA No.	NTIS No.
Metals Mining	10	Midwest Research Institute	9/1976	SW 132c	PB 261 052
Textiles	22	Versar, Inc.	6/1976	SW 125c	PB 258 953
Inorganic Chemical	281	Versar, Inc.	3/1975	SW 104c	PB 244 832
Rubber and Plastics	282, 30	Foster D. Snell, Inc.	3/1978	SW 163c.1-4	PB 282 070-073
Pharmaceuticals	283	Arthur D. Little, Inc.	1976	SW 508	PB 258 800
Paint and Allied Products	285	Wapora, Inc.	9/1975	SW 119c	PB 251 669
Organic Chemicals, Pesticides, Explosives	286, 2879, 2892	TRW Systems	1/1976	SW 118c	PB 251 307
Petroleum Refining	2911	Jacobs Engineering Co.	6/1976	SW 129c	PB 259 097
Petroleum Rerefining	2992	--	1977	SW 144c	PB 272 267
Leather Tanning and Finishing	3111	SCS Engineers, Inc.	11/1976	SW 131c	PB 261 018
Metal Smelting and Refining	33	Calspan Corp.	4/1977	SW 145c.1-4	PB 276 169-172
Electroplating and Metal Finishing	3471	Battelle Columbus Labs	9/1976	SW 136c	PB 264 349
Special Machinery Manufacturing	355, 357	Wapora, Inc.	4/1977	SW 141c	PB 265 981
Electronics Components Manufacturing	367	Wapora, Inc.	1/1977	SW 140c	PB 265 532
Storage and Primary Batteries	3691, 3692	Versar, Inc.	1/1975	SW 102c	PB 241 204

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5.4 OTHER SOURCES

5.4.1 Office of Solid Waste

The Hazardous Waste Management Division of the Office of Solid Waste provided a summary of hazardous waste quantities generated by EPA region and state. Unfortunately, these data could not be correlated with either the assessment reports or state data. (We were told that this summary was prepared from the assessment reports, but were unsuccessful in correlating the OSW summary quantity values with these reports.)

Region X provided "An Evaluation of the Status of Hazardous Waste Management in Region X," December, 1975. This report describes how certain wastes within various SIC codes are disposed of in the Pacific Northwest and was of use as a cross-check.

5.4.2 Trade/Technical Associations

The Association of Metropolitan Sewerage Agencies furnished a report, "Field Report on Current Practices and Problems on Sludge Management," June, 1976. These data were not specific enough to be used in this study. Other trade associations had already furnished data to the OSW, and we were referred to these reports.

5.5 SUMMARY

As described in Section 3, a decision was reached during the data collection phase to use the assessment report data for waste quantity information, and the state reports and other data sources for waste type and waste disposal method information. At the conclusion of the data collection phase, we reviewed the information available, and attempted to decide whether enough information had been collected to allow determination of useful estimates for the United states as a whole.

This questions was answered affirmatively for the SIC codes listed in Table 1. In the next section, we will review these data and the estimates and conclusions which we were able to reach.

SECTION 6

NATIONAL HAZARDOUS WASTE AMOUNT QUANTIFICATION

6.1 INTRODUCTION

In order to quantify national amounts of industrial hazardous wastes by waste types and their disposal methods for various SIC codes, a specific methodology was used. This section describes the methodology, and the results of its use.

6.2 METHODOLOGY

The methodology employed is briefly stated in Section 3.2. A more detailed explanation is:

EPA hazardous waste assessment reports were analyzed to determine the information contained on hazardous waste quantities, waste types, disposal methods, etc. for the particular SIC code(s) addressed by the report. Projected national amounts of hazardous or potentially hazardous waste for these different SIC codes for calendar year 1977 were assumed to be valid since the reports' most current surveyed national figures were for calendar years 1972, 1973, 1974, or 1975.

After tabulating these data by waste types and their disposal methods for specific SIC codes, comparisons were made to state hazardous waste studies data. Hazardous waste treatment information and other pertinent comments were annotated during this tabulation.

Data from state studies were used to modify the information in the assessment report if the state data were particularly comprehensive, of high quality or could be used to fill in gaps. These facets were assessed in part in our discussions with state agency staff members on the way in which each report was prepared. In addition, we compared specific SIC code characteristics in a particular state to the national characteristics of that SIC code. This comparison included percentage of populations representated by the SIC code; distribution of manufacturing activities by SIC code subdivisions, and any other information that was found beneficial for the purposes of comparison. This was not an easy task because of the variability in state report formats. Only a few states provided data which allowed this comparison to be made thoroughly.

6.3 STANDARD INDUSTRIAL CLASSIFICATION (SIC) CODES ADDRESSED

As the data were assessed for usefulness in determining national amounts of industrial hazardous waste by waste types and their disposal methods, it became evident that this determination was possible for only those SIC codes addressed by the hazardous waste assessment reports. This was due to the inconsistancy of the state studies and other data sources.

6.3.1 SIC Codes Potentially of Interest

The set of SIC codes of interest initially included all manufacturing SIC codes in which significant quantities of industrial hazardous waste are generated. This set includes codes 26 through 39, except for code 32.

Following the analysis of the data for quality and utility, it was determined that there was enough data only for the SIC codes for which there were EPA assessment reports. These reports address SIC codes 22, 28, 29, 30, 31, 33, 34, 35, and 36.

6.3.2 Criteria for Choosing

The principal criterion used to determine which of the candidate SIC codes would be chosen for further quantification was the availability of data that could be used to determine the national quantity of hazardous waste by waste types and the disposal methods used.

The importance of the SIC code in terms of amounts or severity of industrial hazardous waste was not the determining factor in this choice. However, we note that OSW's proposed list of hazardous waste streams includes streams from six of the nine SIC codes addressed by the assessment reports.

6.3.3 Results of Applying Choice Criterion

After this review, the following codes were chosen for quantification of their industrial hazardous wastes by waste types and by disposal methods:

SIC Code Number	Name
28	Chemicals & Allied Products
29	Petroleum Refining & Related Industries
30	Rubber & Misc. Plastic Products
31	Leather & Leather Products
36	Electrical & Electronic Machinery, Equipment & Supplies

Indeed, only those portions of these two-digit SIC codes which were addressed by the assessment reports were included in this study. We estimate, based on the available data, that these segments of their respective SIC codes generate the bulk (approximately 90 percent) of their SIC code's hazardous waste. These SIC code segments are listed in Table 6-1.

TABLE 6-1. SIC CODE SEGMENTS ADDRESSED BY EPA HAZARDOUS WASTE ASSESSMENT REPORTS WHICH ARE INCLUDED IN THIS STUDY

SIC Code Segment Number	Name
281	Industrial Inorganic Chemicals
282	Plastics Materials & Synthetic Resins, Synthetic Rubber, Synthetic & Other Manmade Fibers, Except Glass
283	Drugs
285	Paints, Varnishes, Lacquers, Enamels, and Allied Products
286	Industrial Organic Chemicals
2879	Pesticides & Agricultural Chemicals, NEC[a]
2892	Explosives
291	Petroleum Refining
2992	Lubricating Oils & Grease
301	Tires & Inner Tubes
302	Rubber & Plastics Footwear
303	Reclaimed Rubber
304	Rubber & Plastics Hose & Belting
306	Fabricated Rubber Products, NEC
311	Leather Tanning & Finishing
367	Electronic Components & Accessories
3691	Storage Batteries
3692	Primary Batteries, Dry & Wet

[a]Not Elsewhere Classified

The SIC code segments listed in Table 6-1 include 94 of the 95 industrial processes named as those which generate hazardous wastes by the EPA in their proposed rules for defining and classifying hazardous wastes in the December 18, 1978, issue of the Federal Register.

6.4 EXAMPLE OF A NATIONAL INDUSTRIAL HAZARDOUS WASTE AMOUNT QUANTIFICATION: BATTERIES INDUSTRY, SIC 3691/3692

Hazardous waste types, amounts, and their methods of disposal were obtained from the appropriate assessment report. In this case it was: "Assessment of Industrial Hazardous Waste Practices, Storage and Primary Batteries Industries," Versar, Inc., January 1975, Report No. PB 241 204. Information available in this assessment report included the quantity of each waste type and general information on disposal methods for the entire batteries industry. Total hazardous waste stream quantities (on a wet basis) were given for each waste type for the years 1973, 1977, and 1983. Hazardous constituents were also given on a dry basis for the same years. The extrapolations for the year 1977 were chosen, as they were for all other SIC codes in this report, because they most closely approximated current waste generation quantities.

The state hazardous waste reports were then consulted. The distribution of disposal methods i.e., onsite and public versus private was determined from these reports. Any indication of changes in disposal methods between 1973 and 1977 was also assessed and used to modify disposal methods distribution estimates. State report data used included data from Arizona, Maine, Nebraska, Oregon, Vermont, and Florida. The EPA Region X report was also used. Tables 6-18 and 6-19 in this report show a summary of our results for "Industrial Hazardous Waste Quantities by Disposal Method" and "Waste Types and Typical Hazardous Waste Constituents by Process," respectively for the batteries industry.

6.5 SUMMARY OF NATIONAL INDUSTRIAL HAZARDOUS WASTE AMOUNT QUANTIFICATION

The results of this study are shown in the following sections by SIC code.

6.5.1 Industrial Inorganic Chemicals, SIC 281

Table 6-2 gives the subcategory distribution of 1977 hazardous waste totals for SIC 281. It also shows the amount of hazardous constituents of these wastes (on a dry basis) in each subcategory and gives total SIC 281 hazardous waste and hazardous constituents quantities.

The distribution of disposal methods are given in Table 6-3. The preponderance of the hazardous waste from SIC 281 is disposed of onsite, primarily in ponds or general purpose landfills. Private offsite disposal accounts for between 10 and 20 percent of the total and public offsite disposal accounts for about 11 percent or 427,000 tonnes, mostly to general purpose landfills.

TABLE 6-2. SIC 281 -- INDUSTRIAL INORGANIC CHEMICALS[a]

Subcategory Distribution of Industrial Hazardous Waste			
Subcategory	Name		Hazardous Waste -- 1977 Tonnes/Year, Wet Basis (Dry Basis)
2812	Alkalies and chlorine		109,000 (56,000)
	Hazardous constituents (tonnes, dry basis):		
	Asbestos	3,800	
	Chlorinated hydrocarbons	1,200	
	Lead	900	
	Mercury	120	
	Sodium/calcium sludge	1,500	
	Total	~7,500	
2813	Industrial gases		Negligible
2816	Inorganic pigments		507,000 (229,000)
	Hazardous constituents (tonnes, dry basis):		
	Antimony compounds	14	
	Arsenic compounds	0.3	
	Cadmium compounds	60	
	Chromium and its compounds	3,560	
	Cyanide compounds	150	
	Lead compounds	1,700	
	Mercury compounds	0.3	
	Zinc compounds	330.6	
	Total	~5,800	

[a]Reference 1

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TABLE 6-2. Continued

Subcategory Distribution of Industrial Hazardous Waste

Subcategory	Name		Hazardous Waste -- 1977 Tonnes/Year, Wet Basis (Dry Basis)
2819	Inorganic Chemicals, N.E.C., Industry		3,270,000 (2,030,000)
	Hazardous constituents (tonnes, dry basis):		
	Arsenic	5.6	
	Chromium	0.4	
	Fluoride	50,500	
	Nickel	0.9	
	Phosphorus	5,300	
	Total	~55,800	
Total SIC 281 Industrial Hazardous Waste:			
Wet Basis -- 3,884,890 tonnes			
Dry Basis -- 2,317,470 tonnes			
Total SIC 281 Industrial Hazardous Waste			
Hazardous Constituents (tonnes dry basis):			
Antimony compounds		14	
Arsenic and its compounds		6	
Asbestos		3,800	
Cadmium compounds		60	
Chlorinated hydrocarbons		1,200	
Chromium and its compounds		3,560	
Cynide compounds		150	
Fluoride		50,500	
Lead and its compounds		2,600	
Mercury and its compounds		120	
Nickel		1	
Phosphorus		5,300	
Sodium/calcium sludge		1,500	
Zinc compounds		330	
	Total	~69,100	

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TABLE 6-3. SIC 281 -- INDUSTRIAL INORGANIC CHEMICALS[a]

Distribution of Industrial Hazardous Waste Disposal Methods			
	Percentage of Distribution		
	Onsite	Offsite	
Disposal Method		Private	Public
Pond storage/disposal	20-29	2-4	--
Burning/incineration	--	<1	--
High-temperature processing	1-2	--	--
Municipal sewers	--	--	<1
Burial:			
Specialized disposal sites	<0.1	0.1	--
General purpose landfills	45	3	11
General purpose landfills approved hazardous wastes	--	5	--
Approved landfills for large volume hazardous waste	3	≤1	<1
General purpose secured landfill	--	≤5	--
Deep well injection	--	≤1	--
Ocean barging	--	≤1	--
Totals	69-79	10-20	11
Tonnes/Year, 1977	2,680,000-	388,000-	427,000
(Wet basis)	3,070,000	777,000	
Total Industrial Inorganic Chemicals Industry Hazardous Waste: 3,885,000 Tonnes/Year, 1977 (Wet Basis)			

[a]References 1, 14, 16, 18, and 20

6.5.2 Plastics and Synthetics, SIC 282

Industrial hazardous waste quantities classified by disposal method are given in Table 6-4 for SIC 282. The bulk of the wastewater sludges that go to unknown disposal facilities may well end up in municipal landfills but this is not certain.

Hazardous constituents in the wastes of this industry include organics (toxics and flammables) and some heavy metals.

6.5.3 Pharmaceuticals, SIC 283

As can be seen from Table 6-5, this industry incinerates the majority of its waste while the remainder is either treated and disposed of or recovered. A very small amount ($\leq$90 tonnes/year) of mixed solvent is disposed of in municipal sewers.

6.5.4 Paints and Coatings, SIC 285

It was not possible to determine specific disposal methods used for each waste type for this industry. Table 6-6 shows the number of plants which used particular disposal options in 1972 for specific waste types.

The bulk of the raw material packaging wastes and dust from air pollution control equipment is disposed of in routine periodic pickups. These routine pickups are the same ones in which ordinary trash (paper, etc.) would be removed for disposal, commonly at municipal landfills. Therefore, the assumption is made that half ends up in a public facility and half in a private facility. Wastewater sludge and spills and spoiled batches are probably picked up by contract haulers and disposed of in private sites. Waste organic cleaning solvent is either recovered or incinerated onsite or offsite.

Hazardous constituents in paints and coatings include organics (toxics and flammables) and heavy metals.

6.5.5 Organic Chemicals, SIC 2861, 2865, 2869 (except 28694)

Inconsistent information is available on the types of waste in this industry. Each state report has its own listing of waste types. The assessment report did not specify waste types other than to mention several in its text. Consequently, no quantification by waste type was possible. Typical wastes for this industry include solvents, corrosives (acid and bases), sludges (heavy metal and paint), still and tank bottoms, oils, toxics (organic and inorganic), etc.

Table 6-7 depicts the distribution by disposal method for the total hazardous waste generated by the organic chemicals industry in 1977. We estimate that municipal disposal accounts for 20 percent or less of offsite disposal. The offsite disposal total given in the table appears low and should be increased to between 5 and 15 percent of the total. This is primarily due to the increased use of contract incineration and solvent recovery vendors. The amount going to municipal disposal would

TABLE 6-4. SIC 282 -- PLASTICS AND SYNTHETICS[a]

Industrial Hazardous Waste Quantities by Disposal Methods					
Waste Type	Total Hazardous Waste Tonnes/Year, 1977 (Wet Basis)	Disposal Methods Tonnes/Year, 1977 (Wet Basis)			
		Onsite	Offsite		Unknown
			Private	Public	
Liquid phenolics	322,000	161,000[b]	161,000[c]	--	--
Phenolic sludges	44,000	44,000[d]	--	--	--
Amino resins	20,700	--	20,700[c]	--	--
Still bottoms	54,300	27,100[e]	27,100[e]	Minor Quantities	--
Catalyst wastes	5,360	5,360[b]	--	--	--
Wastewater sludges	284,000	--	--	--	284,000[f]
Totals	~730,000	~237,500	208,800	Minor Quantities	284,000

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[a] References 2, 14, and 17
[b] Drummed and stored
[c] Incinerated
[d] Drummed or lagooned
[e] Incinerated; since the distribution was not given, parity was assumed
[f] Small amount to landfills of unknown locations; then remainder to unknown disposal methods

TABLE 6-5. SIC 283 -- PHARMACEUTICALS[a]

Industrial Hazardous Waste Quantities by Disposal Method[b]						
Waste Type	Total Hazardous Waste Tonnes/Year, 1977 (Wet Basis)	Disposal Methods Tonnes/Year, 1977 (Wet Basis)				
		Onsite		Offsite (Private)		
		Incineration	Other[c]	Incineration	Landfill	Recovery[d]
Mixed solvents	15,400	6,240	--	9,160	--	--
Nonhalogenated solvents	26,900	10,740	--	16,200	--	--
Halogenated solvents	3,900	870	--	3,000	--	--
Organic chemical residue	15,000	6,120	1,530[e]	5,800	1,800	--
High inert content wastes containing:						
• flammables only	1,900	490	--	460	950	--
• heavy metals or corrosives	1,900	--	--	--	1,900	--
Heavy metal waste	3,300	--	--	--	2,600	670
Aqueous mixed solvents	2,800	970	90[f]	1,700	--	--
Aqueous alcohol	700	280	--	400	--	--
Antiviral vaccines	350	115	115[g]	120	--	--
Other biologicals (toxoids, serum)	230	--	230[g]	--	--	--
Returned goods and contaminated or decomposed active ingredients	600	60	120[h]	--	420	--
Totals	73,200	26,000	2,100	36,800	7,700	670

[a]References 3, 14, and 17

[b]Does not include deep well disposal of certain liquid hazardous wastes. This type of disposal occurs almost exclusively onsite. Common constitutents of such waste include acetates, ammonia, bromides, chlorides, alcohols, esters, ethers, ketones, and other organics.

[c]Disposal method explained below in footnotes for each entry in table.

[d]The recovery considered here is heavy metal recovery from waste since solvent recovery is a very common onsite practice at pharmaceutical plants and extremely difficult to quantify.

[e]Diluted and sent to onsite biological wastewater treatment facility.

[f]Treatment in onsite biological wastewater treatment facility or sewered to municipal system.

[g]Autoclaved onsite and disposed of offsite in either a municipal or private landfill.

[h]Material is crushed and slurried with water, and the resultant slurry is sent to an onsite biological wastewater treatment facility.

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TABLE 6-6. SIC 285 -- PAINTS AND COATINGS[a]

Industrial Hazardous Waste Quantities by Disposal Method					
Waste Type	Total Hazardous Waste Tonnes/Year, 1977 (Wet Basis)	Disposal Methods No. of Plants, 1972 (Basis: 1,544 plants)			
		Onsite		Offsite	
		Incineration	Landfill[b]	Incineration	Landfill[b]
Raw material packaging wastes[c]	2,000	5	70	50	1,470
Wastewater sludge	2,300[d]	--	50	--	1,070
Spills and spoiled batches	11,800	--	70	--	1,470
Waste organic cleaning solvent	94,800	5	50	20	950
Dust from air pollution control equipment	1,800	--	50	--	950
Total	112,700				

T-1772

[a]Reference 4
[b]The term landfill may include open dumps, sanitary landfills, secured landfills, etc.
[c]Plant total for disposal methods adds to more than the total number of plants since some plants use two or more disposal methods.
[d]This value is from: "Waterborne Wastes of the Paint and Inorganic Pigments Industries," Southern Research Institute, EPA-670/2-74-030, March 1974.

TABLE 6-7. SIC 2861, 2865, 2869 (EXCEPT 28694) -- ORGANIC CHEMICALS[a]

Industrial Hazardous Waste Quantities by Disposal Method Tonnes/Year, 1977 (Wet Basis)		
Method	Quantities	
	Onsite	Offsite[b]
Landfill	483,000	113,000
Incineration	~2,250,000	51,000[c]
Controlled	(699,000)	(--)
Uncontrolled	(1,550,000)	(--)
Deep Well	6,540,000	--
Biological Treatment/Lagoon	565,000	--
Recovery	267,000	--
Landfarm	NA[d]	--
Totals	~10,100,000	164,000[e]
Total Organic Chemicals Industry Hazardous Waste: ~10,300,000 tonnes/year, 1977 (Wet Basis)		

[a] References 5 and 14
[b] Predominantly private except for minot portions (<20%) disposed fo legally, illegally, or unknowingly in municipal landfills and/or incinerators.
[c] Largely controlled (>90%) due to regulations which contract incinerator operations must satisfy to destroy a variety of wastes.
[d] Not available
[e] The amount given here is believed to be low. The actual quantity disposed of offsite is believed to be between 5 and 15 percent of the total.

still be fairly low even with this revised offsite estimate. It would be somewhere between 2 and 5 percent of the total and would primarily go to some form of landfill.

6.5.6 Pesticides, SIC 28694/2879

Disposal location for the pesticides industry was extremely difficult to ascertain from the available data. This is reflected in Table 6-8 by the fact that no entries are given in the offsite (public) and (private) columns for the various disposal methods but entries are given in the site undetermined column. This column is footnoted to indicate the estimated distribution between offsite (public) and (private) disposal methods.

Hazardous wastes for this industry include waste pesticides; pesticide contaminated items such as packaging materials; cleanup residues such as contaminated articles, wastewater, solvent, floor sweepings, etc.; and other miscellaneous waste types.

6.5.7 Explosives, SIC 2892

Very little hazardous waste from the explosives industry is disposed of in municipal facilities. The bulk of these wastes is disposed of onsite (by open-burning or landfill). A small amount is handled by contract disposal firms (by open-burning or chemical detoxification). Table 6-9 gives waste types; amounts and the distribution of disposal methods for both the private explosive and government-owned contractor-operated (GOCO) segments of this industry.

6.5.8 Petroleum Refining, SIC 2911

Municipal landfills are responsible for accepting approximately 23 percent of the hazardous waste generated by this industry (Table 6-10). This waste is made up of the waste types listed on Table 6-11. Hazardous constituents of each waste type are also included on this table. No breakout was possible as to which waste types are disposed of municipally. It can only be assumed that a portion of each waste type found its way to municipal landfills.

6.5.9 Petroleum Rerefining, SIC 2992

Table 6-12 depicts hazardous waste disposal by waste type for petroleum rerefining. Public landfills accept almost 10,000 tonnes/year of this industry's hazardous waste. Most of this waste has been treated to inhibit heavy metal leaching prior to disposal. Hazardous waste constituents of the waste types are given on Table 6-13.

6.5.10 Rubber Products, SIC 30

Over 70 percent of the hazardous waste generated by this industry finds its way to municipal landfills, either of the general purpose or the approved hazardous waste varieties (Table 6-14). Principal hazardous constituents of the waste are oils, toxic organics, and heavy metals.

TABLE 6-8. SIC 28694/2879 -- PESTICIDES[a]

Industrial Hazardous Waste Quantities by Disposal Methods Tonnes/Year, 1977 (Wet Basis)				
Method	Onsite	Offsite		Site Undetermined
		Private	Public	
Landfill	175,000	--	--	75,000[b]
Incineration	--	--	--	100,000[c]
Storage[d]	81,000	--	--	--
Recovery	--	--	--	50,000[e]
Unknown[f]	--	--	--	144,000
Totals	256,000	Not Available	Not Available	369,000
Total Pesticides Industry Hazardous Waste: 625,000 Tonnes/Year, 1977 (Wet Basis)				

T-1826

[a] References 5, 14, 17, 19, and 20

[b] This amount is split between offsite public and private. A conservative estimate would be 25,000 tonnes to offsite public disposal and 50,000 tonnes to offsite private disposal.

[c] Largely offsite private (>95%) and controlled (>90%) due to regulations that contract incinerator operations must satisfy to destroy a variety of wastes.

[d] In drums or open piles

[e] This amount is split between onsite and offsite private. It is believed that recovery occurs almost exclusively onsite with only a minor portion (<1%) recovered offsite.

[f] Includes onsite and offsite private chemical detoxification and subsequent disposal; usually offsite landfill (public and private), deep well disposal (minor), and other unspecified disposal methods.

TABLE 6-9. SIC 2892 -- EXPLOSIVES[a]

Industrial Hazardous Waste Quantities by Disposal Method						
Industry Segment	Waste Type	Total Hazardous Waste Tonnes/Year, 1977 (Dry Basis)	Disposal Methods Tonnes/Year, 1977 (Dry Basis)			
			Open Burned[b]	Landfilled	Sold	Other[c]
Private Explosives Industry:	Fixed high explosive waste	~460	>430	Negligible	<5	<26
	Blasting agents	~1,200	>1,100	Negligible	<12	<74
	Subtotals	~1,700 (~5,500-Wet Basis)	>1,500	Negligible	<17	<100
Government Owned, Contractor Operated (GOCO) Explosives Industry:	Explosive wastes	4,900	4,800	--	140	--
	Explosive contaminated inert wastes	14,700	13,700	1,000	--	--
	Other hazardous wastes[d]	240	90	140	20	--
	Subtotals	~19,000[e]	18,600	1,140	160	--
Explosives Industry Grand Totals		~21,500 (~25,400-Wet Basis)	20,100	1,140	~180	<100

T-1774

[a] Reference 5
[b] Predominantly onsite, >90 percent
[c] Includes chemical detoxification and subsequent disposal; usually landfill, deep well disposal, spray irrigation, lagooning, ect.
[d] Includes spent activated carbon from processing aqueous hazardous wastes (open burned), red water from TNT purification (evaporated and sold), organic solvents from propellant manufacture, and wastewaters containing dissolved and suspended RDX/HMX
[e] Dry Basis = Wet Basis

TABLE 6-10. SIC 2911 -- PETROLEUM REFINING[a]

Industrial Hazardous Waste Quantities by Disposal Method Tonnes/Year, 1977 (Wet Basis)			
Method	Onsite	Offsite	
		Public	Private
Landfill	355,000	428,000	107,000
Lagoon	284,000	--	289,000
Landspread	334,000	--	4,000[b]
Incinerate	40,000	--	
Totals	1,013,000	428,000	400,000
Total Petroleum Refining Industry Hazardous Waste: ~1,840,000 Tonnes/Year, 1977 (Wet Basis)			

[a]References 6, 17, and 20
[b]Distribution unknown

TABLE 6-11. SIC 2911 -- PETROLEUM REFINING[a]

Waste Types and Hazardous Constituents	
Waste Types	Constituents
Leaded Gasoline Sludge	Organic lead vapors, phenols and heavy metals
Cooling Tower Sludge	Heavy metals
Crude Tank Bottoms	Oil and heavy metals
Dissolved Air Flotation (DAF) Float	Oil and heavy metals
Exchanger Bundle Cleaning Sludge	Oil and heavy metals
Slop Oil Emulsion Solids	Oil and heavy metals
Once-Through Cooling Water Sludge	Oil and heavy metals
Waste Bio Sludge	Oil and heavy metals
Storm Water Silt	Oil and heavy metals
Spent Lime from Boiler Feedwater Treatment	Oil and heavy metals
Kerosene Filter Clays	Oil and heavy metals
Non-Leaded Tank Bottoms	Oil and heavy metals
API Separator Sludge	Oil and heavy metals
Lube Oil Filter Clays	Oil and heavy metals
FCC Catalyst Fines	Heavy metals
Coke Fines	Heavy metals
Neutralized Hydrofluoric Acid Alkylation Sludge	Oil and heavy metals

[a]Reference 6

TABLE 6-12. SIC 2992 -- PETROLEUM REREFINING[a]

Industrial Hazardous Waste Quantities by Disposal Method								
Waste Type	Total Hazardous Waste Tonne/Year, 1977 (Dry Basis)	Disposal Methods Tonnes/Year, 1977 (Dry Basis)[b]						
				Landfill, Offsite				
		Landfill, Onsite		Public		Private		Recycled/Reused
		Treated[c]	Untreated	Treated	Untreated	Treated	Untreated	Onsite & Offsite
Acid Sludges	38,730	6,200	--	3,700	900	20,000	7,900	--
Caustic and other Sludges	15,400	--	--	--	--	--	--	15,400
Spent Clay	20,190	1,900	--	4,100	1,000	6,500	6,600	--
Totals	74,300	8,100	--	7,800	1,900	26,500	14,500	15,400

[a]Reference 7

[b]Dry basis approximates wet basis since caustic sludges contain only a slight amount of moisture.

[c]Treated means acid neutralization by mixing with cement dust, lime, or other alkaline materials.

T-1775

TABLE 6-13. SIC 2992 -- PETROLEUM REREFINING[a]

Waste Type	Hazardous Waste Constituents								
	Constituents Tonnes/Year, 1977 (Dry Basis)								
	Acid	Oils[b]	As	Ba	Cd	Cr	Cu	Pb	Zn
Acid Sludges	11,600	13,000	2.4	37.8	0.8	0.4	3.8	581	81
Caustic and other Sludges	--	5,600	0.8	15.5	0.4	0.6	1.9	232	32
Spent Clay	--	4,000	--	--	--	--	--	85	--
Totals	11,600	22,600	3.2	53.3	1.2	1.0	5.7	898	113

T-1776

[a]Reference 7
[b]Oils include petroleum oils, polymers, polar compounds, and asphalt.

TABLE 6-14. SIC 30 -- RUBBER PRODUCTS[a]

Industrial Hazardous Waste Quantities by Disposal Method							
Waste Type	Total Hazardous Waste Tonnes/Year, 1977 (Dry Basis)	Disposal Methods Tonnes/Year, 1977 (Dry Basis)[b]					
		Onsite			Offsite		
		Landfill/Dump	Landspreading	Interim Storage	General Purpose Landfill[c]	Approved Hazardous Waste Landfill[d]	Secure Landfill[d]
Floor Sweepings	~9,500	450	--	--	9,000	--	Negligible
Air Pollution Control Equipment Dust	~41,200	1,950	--	--	38,200	1,000	Negligible
Oily Wastes	~1,500	--	70	--	--	1,400	Negligible
Banbury Mixer Seal Oils	100	--	--	100	--	--	--
Totals	~52,300	2,400	70	100	47,200	2,400	Negligible

T-1777

[a] References 8, 12, 13, 14, 15, and 19
[b] Dry basis = wet basis
[c] Believed to be largely public, ~80%
[d] Believed to be largely private, ~80%

6.5.11 Leather Tanning and Finishing, SIC 3111

Public disposal of hazardous waste accounts for 91,700 tonnes/year or over 50 percent of the total hazardous waste generated by this industry. Table 6-15 shows the distribution of quantities of hazardous waste by disposal method, onsite and offsite, private and public. Waste types are footnoted for particular disposal methods. Hazardous waste constituents are heavy metal compounds, principally those of chromium, lead, zinc, and copper.

6.5.12 Electronic Components, SIC 367

A significant portion of the hazardous wastes generated by the electronic components industry is disposed of (~44 percent) in municipal landfills (Table 6-16). A portion of all the wastes of this industry find their way to municipal landfills. Typical hazardous constituents which make up these wastes are given on Table 6-17.

6.5.13 Batteries, SIC 3691/3692

Public disposal in general purpose landfills accounts for over 47,000 tonnes of hazardous waste being disposed of by this industry on an annual basis (Table 6-18). Waste types for particular processes within the industry are given on Table 6-19. The two waste types for this industry are wastewater effluent treatment sludges and rejected and scrap batteries/cells. This table also gives amounts of hazardous constituents for each waste type for each manufacturing process.

6.5.14 Industrial Hazardous Waste Municipally Disposed

The following table summarizes the amount of industrial hazardous waste being disposed of in the municipal sector for those SIC codes included in this study. This table was developed from information included on Tables 6-3 through 6-18, inclusive:

Type of Municipal Disposal Facility	Industrial Hazardous Waste Amount (Tonnes/Year, 1977 (Wet Basis)
General Purpose Landfill	~1,543,000
Dumps	~38,500
Lagoons, trenches, pits, ponds, etc.	~7,300
Approved Hazardous Waste Landfills	500
Sewer	≤90
Total	~1,589,000

TABLE 6-15. SIC 3111 -- LEATHER TANNING AND FINISHING[a]

Industrial Hazardous Waste Quantities by Disposal Method Tonnes/Year, 1977 (Wet Basis)			
Method	Quantities		
		Offsite	
	Onsite	Private	Public
Landfill[b]	4,800	51,200	45,800
Dumps[b]	1,900	2,100	38,500
Lagoons, Trenches, Pits, Ponds, etc.[c]	5,300	6,200	7,300
Certified Hazardous Waste Disposal Facility[b]	--	9,700	--
Totals	12,000	69,200	91,600
Total Leather Tanning and Finishing Industry Hazardous Waste: ~173,000 Tonnes/Year, 1977 (Wet Basis)			

[a] References 9, 14, 15, 17, 19, and 20
[b] Waste types disposed of by these methods include: trimmings and shavings, finished and unfinished leather trim, buffing dust finishing residues, wastewater screenings, and sewer sump and dewatered wastewater or treatment sludges
[c] These methods are primarily for sludges. Some of the other waste types may intentionally or inadvertently be disposed of via these methods

TABLE 6-16. SIC 367 -- ELECTRONIC COMPONENTS[a]

Industrial Hazardous Waste Quantities by Disposal Method						
Waste Type	Total Hazardous Waste Tonnes/Year, 1977 (Wet Basis)	Disposal Methods Tonnes/Year, 1977 (Wet Basis)				
		Onsite		Offsite		
		Landfill	Incinerator[b]	Public (Landfill)	Private	
					Landfill	Incinerator[b]
Nonreclaimable halogenated solvents and still bottoms	2,400	200	--	1,100	1,100	--
Nonreclainable nonhalogenated solvents and still bottoms	16,600	1,700	--	7,500	7,400	--
Wastewater treatment sludges	50,800	7,600	--	21,600	21,600	--
Lubricating and hydraulic oils	~2,400	--	--	1,200	1,200	--
Paint wastes	200	--	6	200	10	6
Totals	~72,400	9,500	6	31,600	31,310	6

T-1778

[a] References 10, 14, and 19

[b] Resultant ash is disposed of either in onsite or offsite private secure landfills. It is estimated that this ash amounts to approximately one (1) to two (2) tonnes and is contaminated with heavy metal oxides and salts.

TABLE 6-17. SIC 367 -- ELECTRONIC COMPONENTS[a]

Typical Hazardous Waste Constituents
Nonreclaimable halogenated solvents and still bottoms:
Perchloroethylene
Trichloroethane
1,1,1-Trichloroethylene
Freons
Methylene Chloride
Still bottoms from reclamation of above solvents
Nonreclaimable nonhalogenated solvents and still bottoms:
Mixed solvents (halogenated and nonhalogenated)
Methanol
Acetone
Alcohols
Proprietary photoresists
Xylene
Still bottoms from reclamation of above solvents
Wastewater treatment sludges:
Particulate metals and oxides
Chemically precipitated anions and cations
Oils
Solvents
Lubricating and hydraulic oils:
Water soluble oils
Petroleum derived oils
Paint wastes:
Spray booth filters
Clean-up rags
Solvent/paint mixtures

[a]Reference 10

TABLE 6-18. SIC 3691/3692 -- BATTERIES[a]

Industrial Hazardous Waste Quantities by Disposal Method Tonnes/Year, 1977 (Wet Basis)			
Method	Quantities		
	Onsite	Offsite	
		Public	Private
General purpose landfill[b]	45,200	47,200	47,200
Secured landfill[c]	12,300	--	12,300
Reclaimed/recovered/sold	10	--	--
Totals	57,510	47,200	59,500
Total Batteries Industry Hazardous Waste: ~164,000 Tonnes/Year, 1977 (Wet Basis)			

[a]References 11, 14, and 20

[b]This type of landfills accepts a wide variety of wastes. There are usually no environmental protection provisions for hazardous wastes such as special containment, monitoring, or leachate treatment. Exact classification can range from open dump to sanitary landfill.

[c]This type of landfill employs environmental protection provisions, is usually located in a geologically and hydrologically suited area, prohibits certain wastes, maintains records, and is licensed or permitted by the state it is in.

TABLE 6-19. SIC 3691/3692 -- BATTERIES[a]

SIC 3691: Waste Types and Typical Hazardous Waste Constituents by Process									
Process	Waste Types	Total Hazardous Waste Tonnes/Year, 1977 (Wet Basis)	Constituents Tonnes/Year, 1977 (Dry Basis)						
			Lead	Cadmium	Nickel	Silver	Zinc	Mercury	Miscellaneous
Lead-Acid	Wastewater Effluent Treatment Sludge	163,000	450[b]	--	--	--	--	--	--
Nickel-Cadmium	Wastewater Effluent Treatment Sludge	44	--	--	--	--	--	--	$Cd(OH)_2$ = 12 $Ni(OH)_2$ = 3.7
	Rejected and Scrap Cells	5	--	2.3	1.4	--	--	--	--
Other Storage Batteries:		3[c]	--	0.044	--	0.13	0.014	0.0002	Water treatment sludges containing silver and cadmium = 1.2
Cadmium-Silver Oxide	Wastewater Effluent Treatment Sludge	NA[d]	--	--	--	--	--	--	--
	Rejected and Scrap Cells	NA	--	--	--	--	--	--	--
Zinc-Silver Oxide	Rejected and Scrap Cells	NA	--	--	--	--	--	--	--
	Totals	~163,000	450	2.3	1.4	0.13	0.014	0.0002	--

[a]Reference 11
[b]Lead equivalent of lead and lead compounds contained in sludge
[c]Reclaimed
[d]Not available

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TABLE 6-19. Concluded

SIC 3692: Waste Types and Typical Hazardous Waste Constituents by Process								
Process	Waste Types	Total Hazardous Waste Tonnes/Year, 1977 (Wet Basis)	Constituents Tonnes/Year, 1977 (Dry Basis)					
			Zinc	Lead	Nickel	Mercury	Cadmium	Miscellaneous
Carbon-Zinc	Rejected and Scrap Batteries	1,100	380	0.03	--	0.67	0.03	$ZnCl_2$ = 29
Alkaline-Manganese	Rejected and Scrap Batteries	165	27	--	--	1.3	--	--
Mercury	Rejected and Scrap Batteries	8	5	--	--	0.02	--	HgO = 0.07
Magnesium-Carbon	Wastewater Effluent Treatment Sludge	120	--	--	--	--	--	$Cr(OH)_2/CrCO_3$ sludge = 47.8
Zinc-Silver Oxide	Rejected and Scrap Batteries	6[a]	0.01	--	--	0.0007	--	Ag_2O = 0.003
Other Primary Batteries:								
Carbon-Zinc Air Cell	Rejected and Scrap Batteries	55	2	--	--	0.007	--	--
Weston Mercury Cell	Rejected and Scrap Batteries	0.009	--	--	--	Neglig.	Neglig.	--
Magnesium Reserve Cell	Rejected and Scrap Batteries	NA[a,b]	--	--	--	--	--	--
Lead-Acid Reserve Cell	Rejected and Scrap Batteries	25	--	14	8	--	--	--
	Wastewater Effluent Treatment Sludge	0.6	--	--	--	--	--	Sludge containing nickel and lead = 0.2
	Totals	~1,500	~410	~14	8	~2.0	0.03	--

[a]Reclaimed
[b]Not available

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APPENDIX

STATE OFFICES FROM WHICH DATA WERE SOUGHT; TYPE OF DATA RECEIVED

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Industrial Solid Waste Survey, Arizona Department of Health Services, Bureau of Sanitation, June 3, 1974.

Report to the Arizona Department of Health Services on Industrial and Hazardous Wastes, prepared by Behavioral Health Consultants, Inc., June 1975.

Arizona Hazardous Waste Generation Survey Data, Arizona Department of Health, Division of Solid Waste and Vector Control, 1977.

ARKANSAS

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Hazardous Waste Manifest Forms, Hazardous Waste Management Section, California Department of Health, 1978.

Annual summary data on type of waste and type of disposal

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Industrial Process Waste Survey, Office of Solid Waste Management, Connecticut Department of Environmental Protection, August 1977.

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Water Resources Section
Edward Tatnall Building
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Dover, Delaware 19901
(302) 678-4761

Hazardous Waste Generation List, Delaware Department of Natural Resources and Environmental Control, Solid Waste Management Section, post 1975.

FLORIDA

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Hazardous Waste Section
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Hazardous Waste Survey, Florida Department of Environmental Regulation, Solid Waste Management Program, October 1977.

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Idaho Solid Waste Management, Industrial Survey Report, Idaho Department of Environmental and Community Services, June 1973.

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KANSAS

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Hazardous Waste Survey of Kentucky, Kentucky Department of Natural Resources and Environmental Protection, January 1978.

LOUISIANA

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Interim Report -- Industrial Solid Waste Survey and Hazardous Waste Regulatory Considerations, prepared for Louisiana Office of Science, Technology and Environmental Policy, by Owen and White, Inc., Baton Rouge, Louisiana, November 1978.

MAINE

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Solid Waste Management Division
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Department of Environmental Protection
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Augusta, Maine 04333
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MAINE (Continued)

State of Maine Hazardous Waste Survey Report, prepared for Solid Waste Management Division, State of Maine Department of Environmental Protection, by SCS Engineers, Augusta, Maine, July 1978.

MARYLAND

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Water Resources Administration
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Report on Hazardous Waste Practices, Environmental Health Administration, Maryland Department of Health and Mental Hygiene and Maryland Environmental Services, Department of Natural Resources, May 1977.

MASSACHUSETTS

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MICHIGAN

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Impact of Hazardous Waste Generation in Minnesota, Minnesota Pollution Control Agency, Division of Solid Waste, October 1977.

MISSISSIPPI

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Special Waste Survey Report, August 1974-September 1975, Mississippi State Board of Health, Division of Solid Waste Management and Vector Control, 1975.

MISSOURI

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Proper Disposal of Hazardous Wastes in Missouri, Missouri Department of Natural Resources, December 1976.

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Hazardous Wastes in Montana -- A Survey of Waste Generation and Management Practices, Montana Department of Health and Environmental Sciences, Environmental Sciences Division, December 1977.

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Industrial and Hazardous Waste Generation in Nebraska, Solid Waste Pollution Control Division, Nebraska Department of Environmental Control, December 1976.

NEVADA

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Preliminary Study -- Hazardous Waste in New York State, New York State Department of Environmental Conservation, January 1975.

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1975-1976 Ohio Industrial Waste Survey -- Survey Results, Ohio EPA, Office of Land Pollution Control, 1976.

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Oklahoma Controlled Industrial Waste Projected Inventory -- Annual Basis, Oklahoma State Department of Health, Industrial and Solid Waste Division, March 1978.

OREGON

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Hazardous Waste Management Planning 1972-1973, Oregon Department of Environmental Quality, March 1974.

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Hazardous Solid Waste Management Report -- Vol. 1 and 2, Pennsylvania Department of Environmental Resources, prepared by R. F. Weston, Inc., Environmental Consultants-Designers, November 1976.

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Rhode Island Hazardous Waste Report, Rhode Island Department of Health, Division of Solid Waste Management, March 1977.

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Survey of Hazardous Waste Generation and Disposal Practices in South Carolina, Solid Waste Management Division, South Carolina Department of Heatlh Environmental Control, September 1978.

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Industrial Solid Waste Report, State of Tennessee Department of Public Health, 1971.

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Vermont Industrial Waste Survey -- Status Report, Division of Environmental Engineering, State of Vermont Agency of Environmental Conservation, January 1978.

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Report on Industrial and Hazardous Wastes, Washington Department of Ecology, Solid Waste Management Division, December 1974.

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Hazardous Waste Survey Results, Solid Waste Division, State of West Virginia, Department of Health, 1978.

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Industrial Waste Survey, Division of Environmental Standards, Wisconsin Department of Natural Resources, 1978.

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GLOSSARY

Approved Landfills for Large Volume Hazardous Wates

Landfills designed for particular types of hazardous waste that are generated in large volume. In these landfills, segregated disposal precludes their interaction with other types of waste.

General Purpose Landfills

Landfills which accept a wide variety of wastes. There are usually no environmental protection provisions for hazardous wastes such as special containment, monitoring, or leachate collection and treatment. Exact classification can range from "open dump" to "sanitary landfill."

General Purpose Landfills Approved for Hazardous Wastes

Hazardous wastes are screened before disposal in this type of landfill. Monitoring wells and leachate collection and treatment may be required. Classification of this type of landfill would lie between a "general purpose landfill" and a "general purpose secured landfill."

General Purpose Secured Landfills

These landfills employ environmental protection provisions, are usually located in geologically and hydrologically suited areas, prohibit certain wastes, maintain records, and are licensed or permitted by the state(s) they are in.

Specialized Disposal Sites

These include existing mines, quarries, abandoned government property (e.g., missile silos) and other facilities which make hazardous wastes disposal possible because of their fortuitous geological and environmental isolation.